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Nutrition knowledge and dietary behaviour of members of commercial slimming clubs in Greater Manchester

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Literature review

Abstract

Being overweight is becoming normalised in the UK and obesity is forecast to increase to over half of all adults and a quarter of children by 2050. Obesity has serious health implications and is demanding an increasing percentage of health care budgets, however the NHS has insufficient capacity to meet these needs. In addition, weight loss is rarely sustained following completion of dieting programmes. Commercial slimming club programmes have greater success rates in achieving weight loss than the NHS or self-help methods. The NHS relies on the dissemination of knowledge to effect behavioural change, whereas commercial weight-loss programmes focus on techniques to promote behavioural change, such as modest energy restriction, physical activity, behavioural strategy and long term follow up. The knowledge-attitude-behaviour relationship is complex. Research indicates that nutrition knowledge is poorly correlated with dietary behaviour. Furthermore, the majority of obese individuals have high levels of nutrition knowledge. The use of educational methods to encourage a change in behaviour rather than the dissemination of information is an important distinction. Therefore this review investigates how nutrition knowledge influences clients' dietary behaviour particularly in relation to commercial slimming clubs.

1. Introduction

In Britain, being overweight (defined as having a BMI ≥25 kg/m^2) has become normalised. In 2011, 41% of men and 32% of women were classed as overweight, and a quarter of the UK population were classed as obese (BMI ≥30 kg/m^2) (Ahern et al., 2011). The Foresight obesity project conducted by The Government Office for Science (Butland et al., 2007) predicted that by 2050, 60% of adult men, 50% of adult women and around 25% of children under 16 could be obese. The detrimental health consequences of obesity include increased risk of chronic diseases, such as type 2 diabetes, stroke, coronary heart disease, cancer and arthritis. The Foresight report concluded that due to the obesogenic environment in which people live, obesity cannot be tackled by individuals alone. However, the project recognised that the causes of obesity are complex; for example, the constant availability of energy-dense food, sedentary lifestyles and use of motorised transport contributes to passive obesity.

Obesity prevention and cure are being tackled internationally. With 475 million obese adults and double that number of overweight individuals in the world, costs to healthcare services are high (World Obesity, 2012). In 2008, European nations spent around 2%–8% of their healthcare budgets on obesity and in the USA overweight and obesity expenditure accounted for $147 billion of the total medical expenditure (World Obesity, 2012).

The National Health Service (NHS) does not have the capacity to deliver the required scale of weight-loss programmes and therefore provides referrals to commercial slimming clubs (Lavin, 2006).

The dietary and physical habits of an individual are influenced by their knowledge and attitude towards these behaviours. However, the relationship between knowledge, attitude and behaviour are complex. So what role does nutrition knowledge play in dietary behaviour and how important is nutrition knowledge as an element of dietary behaviour change?

This review explores whether there is a relationship between nutrition knowledge and patterns of dietary behaviour in individuals undergoing commercial weight-loss programmes.

2. Nutrition knowledge and dietary behaviour

The Knowledge-Attitude-Behaviour model (Figure 1) has been proposed to explain the role of knowledge in changing behaviour. It is based on the principle that behaviour changes gradually: the accumulation of knowledge in a health domain initiates a change in attitude; this is followed by the accumulation of a change in attitude which results in change of behaviour (Baranowski et al., 2003).

Two psychology theories that attempt to explain the link between knowledge, attitudes, behaviour, social skills and environmental influences were outlined by Roberts et al., 2011: The first, the health belief model, suggests that behaviour change takes place only if an individual believes that change is both possible and beneficial and that the benefits of the change are greater than the required costs to make the change. The second, the social cognitive theory, not only considers the importance of the knowledge and attitude of an individual in influencing behaviour and behaviour change but acknowledges that external factors such as social and environment can have an impact on behaviour (Roberts et al., 2011).

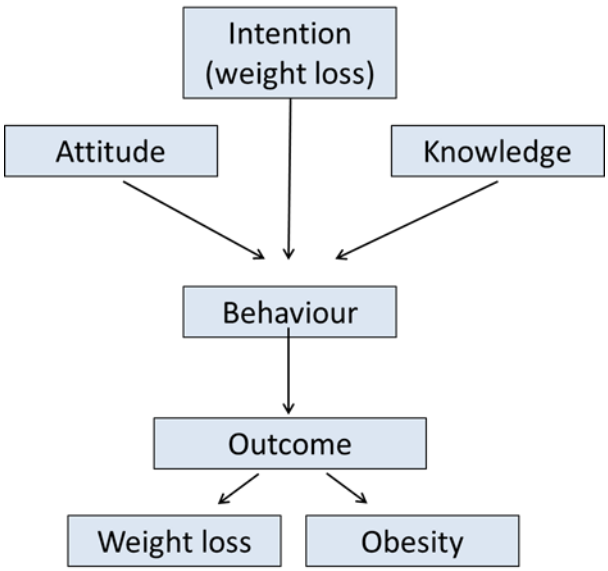

Figure 1. The interactions between attitude-knowledge-behaviour determine whether the outcome will be the desired result (weight loss) or the opposite effect (obesity).

There has been a considerable amount of research undertaken to establish whether there is a relationship between nutrition knowledge, dietary behaviour and obesity; for example, The National Obesity Observatory published a report conducted by the NHS in 2011: "knowledge and attitudes towards healthy eating and physical activity" (Roberts at al., 2011). An earlier review that was based on 217 nutrition intervention studies concluded that those which focused on educational methods to encourage behavioural change rather than the dissemination of information were more effective (Contento et al., 1995). The importance of nutrition knowledge was further demonstrated in a study of obese and overweight low-income mothers which proposed that weight management programmes should include a strong nutrition education component (Klohe-Lehman, 2006). An investigation that was conducted specifically in relation to fat intake suggested that increasing nutrition knowledge may influence dietary behaviour *via* changes in attitude (Shepherd and Towler, 1987). Despite these reports, the relationships between nutrition knowledge, dietary attitudes and behaviour remain to be clearly established.

Worsley proposed that “Nutrition knowledge is the knowledge of nutrients and nutrition”. However in his review, he found no clear evidence that nutrition knowledge influenced food behaviour patterns (Worsley, 2002). The review discussed various methods of measuring nutrition knowledge and concluded that knowledge is not one-dimensional but structured; as such, an individual may only have knowledge about certain aspects of nutrition (Worsley, 2002). Food behaviours are dynamic and the term can cover a wide range of activities, as a consequence, correlation-based statistics on knowledge versus final behavioural outcome do not necessarily reflect the key influences of nutrition knowledge on decision making in relation to dietary behaviour (Worsley, 2002).

The components of knowledge have been described as ‘knowing that’ and ‘knowing how’ which have been further interpreted as declarative and procedural knowledge. Procedural knowledge being defined as knowledge about the way actions are performed, and declarative knowledge as knowledge about facts (Dickson-Spillman, 2011). An example of how these components can be applied in the field of nutrition can be demonstrated by knowing the fibre content of fruit as being declarative knowledge, whereas knowing how to choose between two snacks to select the healthiest is an example of procedural knowledge. Procedural nutrition knowledge has been reported as playing a greater potential role in dietary behaviour (Dickson-Spillman, 2011).

Different studies have applied different methods for assessing the relationship between nutrition knowledge, dietary behaviour and weight outcome. The nutrition knowledge and food intake study carried out by Wardle, Parmenter & Waller (2000) asked 1040 individuals across the UK to respond to a postal nutrition knowledge questionnaire (NKQ) and to complete a food intake questionnaire to determine their consumption of fat, fruit and vegetables. The NKQ also included demographic questions. Correlation between nutrition

knowledge and diet was found to be weak (r=0.2–0.4); however, when the results were represented in terms of meeting recommended fruit, vegetable and fat intake guidelines, nutrition knowledge was found to make an important contribution. The logistic regression odds ratio score for individuals with the highest knowledge quintile was 23.57 at a 95% confidence interval, demonstrating that they were nearly 25 times more likely to be eating a healthy diet compared to those in the lowest knowledge quintile (1.00). Based on these results, the authors concluded that there was a strong association between nutrition knowledge and intake of fruit, vegetables and fat. Furthermore, the association was stronger for fruit and vegetables compared to fat intake (Wardle, Parmenter and Waller, 2000)

A later study by O'Brien & Davies (2007) investigated the relationship between nutrition knowledge and body mass index (BMI) in a sample of 145 adult volunteers recruited from a general practice database in Belfast (91 females and 54 males). This study was carried out using a General Nutrition Questionnaire (originally designed by Parmenter & Wardle, 1999) which included two out of the four subscales: "awareness of dietary recommendations" and "choosing everyday foods". Participants' weights and heights were self-reported and were used to evaluate their BMI's. Although the results indicated that the participants had high levels of nutrition knowledge, they did not show a significant correlation between the level of knowledge and BMI; furthermore, non-parametric Spearman's Rho correlations revealed that the data were not normally distributed (O'Brien & Davies, 2007). In their Discussion, the authors acknowledged that nutrition education is necessary and important but is not sufficient by itself for dietary behaviour change; behavioural interventions and removal of personal and environmental barriers were shown to be more effective (O'Brien & Davies, 2007)

2.1. Food availability and dietary behaviour

Links between obesity and close geographic proximity to supermarkets and fast food outlets have also been studied. However results are divided as to whether the two factors are positively or negatively associated (Fleischhacker et al., 2011): for example, associations have been identified between lower BMI or lower prevalence overweight and obese individuals with closer proximity to supermarkets compared to people with more limited access to supermarkets (the difference was between 1% and 35%); in comparison, obesity levels increased by up to 14% with closer proximity to takeaways (Giskes, 2011). It was suggested that supermarkets carry a wide range of foods and therefore offer an opportunity to purchase healthy foods if cost is not a prohibiting factor, whereas takeaways have a smaller selection of food and higher purchasing power does not increase the choice of healthy food (Giskes, 2011).

The higher use of nutritional panels on food packaging has been associated with greater nutrition knowledge and awareness as well as an increased belief in the importance of diet as a tool to prevent or manage disease (Swinburn et al., 2004). In contrast, lack of knowledge about the nutrient content of foods and the availability of healthy foods have been proposed as a barrier to dietary behavioural change in adolescents. Healthy eating was also found to be strongly linked to self-efficacy, the belief that an individual can behave in a specific way (Gracey et al., 1996).

2.2. Socio-economic-environmental factors

Perceived barriers to weight loss fall into the social and environmental category with respect to nutrition knowledge. A study of obese and overweight patients and their care providers was conducted to assess perceptions towards the barriers to weight loss. The findings showed

that each group had different beliefs: the providers were more likely to perceive the main barriers as lack of self-control in maintaining a diet, the ubiquitous presence of fattening foods in the environment and lack of time for physical activity; in contrast, the patients perceived that weight management was a personal issue that did not necessarily need to be discussed with their health care provider. It is interesting that the patients' perceptions were more focused on self-help than on the wider social implications of a high availability of fattening foods. Medical issues were also believed to be a barrier to weight loss by 70% of patients and 84% of providers, although medical conditions causing obesity are relatively rare (Ruelaz et al., 2007).

Education and income were the focus of a socio-economic study carried out to determine the influence that dietary knowledge had on food purchasing behaviour. A higher level of education was positively correlated with a higher level of nutrition knowledge, whereas participants with low educational attainments gave the lowest scores on nutrition knowledge. Household income was found to have a greater influence on food purchasing behaviour than the level of education. However, household income had very little effect on the association between dietary knowledge and purchasing behaviour, and the data showed that once income had been taken into account the relationship between education and food purchasing behaviour became non-significant (Turrell & Kavanagh, 2005). Dietary behaviour was clearly an independent variable in this case, suggesting that despite people knowing which foods are appropriate, the price of food becomes a major determinant in what they buy.

The relationship between nutrition knowledge and dietary behaviour was assessed in Tehranian adolescent students by both a knowledge, attitudes and practices questionnaire (KAP) and a food frequency questionnaire (FFQ). Interestingly, the nutrition knowledge of the students was positively correlated to the education level of their parents ($r=0.14$, $P<0.001$)

and positively correlated to attitude scores (r=0.24, P<0.001). However, the correlation between nutrition knowledge and dietary behaviour scores for both sexes was weak (r=0.05, non-significant) (Mirmiran et al., 2007).

A German study on dietary behaviour and socio-economic position (SEP) looked more closely at the types of physical activity taken by the different social groups. The study used data from physical examinations by the assessors rather than relying on self-reported heights and weights by the participants. Among women, the results indicated a significant negative association between education and sugar-rich intake, and significant positive associations between education, occupation and income (Finger et al., 2013). In men, the study found a significant positive association between education and alcohol intake. In addition, physical activity played a part in the increased consumption of sugar-rich foods in the diets of males in the lower socio-economic group. The authors concluded that because this group are usually employed in more physically demanding jobs, they rely on energy-dense foods during their work day (Finger et al., 2013).

The variables involved in influencing dietary behaviour have complex interactions and the limitations of some socio-economic studies are that individual factors are difficult to compartmentalise. Even when factors are independent of one another, additional lifestyle effects and circumstances are not fixed and can impact on behaviour. For example, a person may have the same job and shop at the same supermarket over a long period of time but outside influences, such as food advertising and availability of health food at work cannot be excluded from impacting on dietary behaviour. Social acceptance and the desire to conform to the ‘slim’ stereotype may also play a part in decision making for individuals who have the means at their disposal to change their dietary behaviour.

2.3. Education and attitude in dietary behaviour

A significant improvement in dietary behaviour was observed in Indian school children following a six month intervention study involving the provision of nutrition education to pupils, teachers and parents over that time period. The educational intervention focused on making the information fun, varied and innovative; for example, writing posters, performing plays and having cookery lessons (Shah et al., 2010). In the design of this study, care was taken to create a programme of education that was interactive and encouraged behavioural change rather than the simple dissemination of information. Although booklets were provided and lectures were given, the programme included a large element of practical activities for all the groups. In their discussion, the authors explained that the higher level of correct responses to physical activity and healthy cooking practices in the post-intervention questionnaire was due to an increased interest in those aspects that affected everyday life.

The level of nutrition knowledge in health care practitioners has been shown to influence their attitudes and approaches when practicing obesity management. A study of 600 GPs in Southeastern France based on a telephone questionnaire assessed their personal and professional characteristics, attitudes towards overweight and obesity, knowledge and training in weight control and practice methods. The study concluded that the attitudes and opinions of GPs had a greater effect than their level of nutrition knowledge and were the main barrier to appropriate weight-loss management. Furthermore, participation in continuous professional development in weight management was only 54.2%, whereas 80% of the sample acknowledged the need for training, especially in the field of nutrition counselling and behavioural therapy (Bocquier, 2005).

A survey carried out in 2003 examined the knowledge, attitudes, beliefs and eating habits in different groups of health professionals with respect to obesity, nutrition and weight

management (Hankey et al., 2003). The results showed that the level of knowledge varied between practice nurses, GPs and dieticians. Whereas the study sample had a reasonable level of knowledge in nutrition, obesity and weight management, gaps were identified in the nutrition knowledge and weight management of GPs. In addition practice nurses reported feeling unskilled to offer weight management and dietary change advice. Although at the time of the study the Scottish Intercollegiate Guidelines Network (SIGN) clinical guidance on obesity only cautiously proposed a role for commercial slimming groups, a third of the dieticians and half of the GPs were prepared to recommend commercial slimming clubs to patients; (Hankey et al., 2003).

3. Questionnaire design and qualitative research

Although the socio-economic studies described above concluded that nutrition knowledge was an independent factor in relation to changes in dietary behaviour, the design of questionnaires can play a major role in how information on knowledge and behaviour are gathered. Poor measurement of nutrition knowledge has often been cited as a reason for inconclusive findings in studies on the importance of nutrition knowledge and changes in dietary behaviour (Feren et al., 2011). Therefore the designs of NKQs aim to create questionnaires with satisfactory validity and reliability. The use of questionnaires that focus on declarative knowledge as opposed to procedural knowledge has been given as a reason for the limited relationships found between nutrition knowledge and dietary behaviour (Dickson-Spillmann et al., 2011). The authors proposed that procedural knowledge may be more closely related to dietary behaviour and designed a questionnaire to encompass both knowledge types. When the results of the final validated questionnaire were correlated with the results of a FFQ given to participants, they showed a limited correlation of nutrition

knowledge with food intake. They concluded that improved nutrition knowledge leads to increased consumption of healthy foods (Dickson-Spillmann et al., 2011).

In 1999, Parmenter and Wardle developed and validated an NKQ that covered a range of areas that gave results that could be assessed, statistically analysed and compared to previous research (Table 1) (Parmenter & Wardle, 1999). However, studies generally fail to find statistically significant correlations between nutrition knowledge and dietary behaviour, leading to pronouncements that simply changing nutrition knowledge may not lead to the desired outcome in modifying food choice (Wardle, Parmenter & Waller, 2000).

Table 1. Nutrition Knowledge Questionnaire (NKQ) categories (Parmenter & Wardle, 1999).

Category	Number of studies and question example
Expert recommendation on healthy eating	11 studies: e.g. how many servings of fruit and vegetables a day are experts recommending people to eat?
Knowledge of nutrient content of different foods	69 studies: e.g. do you think these foods are high or low in added sugar?
Everyday food choices	10 studies: e.g. if a person wanted to reduce the amount of fat in their diet, which would be the best food choice?
Links between diet and disease	20 studies: e.g. are you aware of any major health problems or diseases that are related to a low intake of fibre?

The Trafford Health and Lifestyle Questionnaire was created in 2006 to collect and assess information relating to quality of life and the health of the population in that specific geographical area. The questions in relation to cooking skills, diet and intention to change diet were all structured so that they could be measured quantitatively. The questions included a combination of closed and visual analogue scales (VAS) and open questions to allow participants to respond freely (Charnley, 2008). The findings from this study enabled the Trafford Primary Care trust to gain a clear picture of the locations and ethnicities of residents with the poorest health behaviours.

An assessment of the nutrition knowledge of obese adults was conducted by carrying out a literature review followed by phone and face-to-face interviews. The draft NKQ was examined by an expert panel for content validity and face validity, and then tested by five students for user friendliness and ambiguity (Table 2). It was pilot tested on obese adults before being released to two student groups, with and without nutrition training, in order to test it for construct validity and re-test validity. The authors concluded that the questionnaire met the criteria for validity and reliability (Feren et al., 2011).

Table 2. Nutrition Knowledge Questionnaires

Author	Questionnaire design	Target Population
Klohe-Lehman, 2006	Six areas of interest: weight loss, prenatal nutrition, child nutrition and the food guide pyramid Heart disease questions were present in the original questionnaire design but were removed due to being too difficult	Convenience sample of 141 mothers and their children were measured for weight and height.
Feren, 2011	An initial draft based on a literature review was given to student testers, then to an obese pilot group. This was followed by a test and retest for construct validity reassessment and reproducibility. The final questionnaire consisted of 91 questions divided into 4 categories: dietary recommendations, sources of nutrients, healthy food choices, and obesity reduction factors	Obese adults
Dickson-Spillman, 2011	The first section was based on interviews with consumers about food and health; the second on recommendations by Swiss nutrition experts, items included the food pyramid and leaflets on healthy alternatives; the third set of items included declarative nutrition knowledge questions on calorie and nutrient contents. 64 questions proposed in original questionnaire, reduced to 20 questions at the end of the development process.	3,000 consumers in the German speaking part of Switzerland
Parmenter & Wardle, 1999	A draft questionnaire was psychometrically tested for validity then piloted using 391 members of general public followed by 168 dietetics students and computer science students. Questions were categorised into 5 areas: understanding of terminology e.g. fibre, awareness of dietary recommendations, knowledge of food sources, practical food choices, awareness of diet disease recommendations	General population
Charnley, 2008	Assessment of quality of life and health of 316 residents in sample population by assessing diet and frequency of consumption of specific foods. Intention to change diet, lifestyle habits and amenity accessibility questions were also asked.	Adults living in Trafford Borough
Stroud, 2013	Nutrition knowledge assessment and dietary assessment designed to assess relationship between nutrition knowledge and food intake using a smartphone app to record intake.	General population
Welsh, Jeffrey 2012	A 39-item questionnaire used to assess perceived barriers (focussing on environmental and motivational barriers to diet and exercise behaviours). Energy intake assessed using Block Food Frequency questionnaire.	Obese adults seeking weight-loss treatment
Mirmiran et al., 2007	Study to determine nutritional behaviour using a validated knowledge, attitudes and practice questionnaire (KAP) with the following categories: weight, type of fat intake, fibre, salt and sugar intake and frequency of consumption and a food frequency questionnaire to assess intake.	7669 adolescents in Tehran
Sapp & Jensen, 1997	Nutrition knowledge test of 23 items including questions on nutrient content and source of nutrient in food and a diet-health awareness test based on knowledge of 27 health problems and eight categories of dietary intake questions.	General adults
Turconi, 2003	Cross-sectional baseline survey covering: personal data, food frequency, food habits, physical activity and lifestyle, healthy and unhealthy diet and food, self-efficacy, barriers to change, nutritional knowledge and food safety, food hygiene	72 adolescent students
Dissen et al., 2011	Cross-sectional survey containing a nutritional knowledge scale, attitude scale, food frequency scale, body satisfaction subscale and demographic characteristic questions	279 students aged 20.12±1.75SD from a large north eastern US university

Qualitative studies differ from quantitative studies in that they aim to provide insights into the experiences of individuals rather than statistically reliable data (Thomas et al., 2008). A

qualitative weight loss study comparing commercial and health service weight-loss groups, classes and clubs used purposive sampling guided by a sampling frame to identify population groups across Scotland from which to collect data (Allan et al., 2011). The collection methods involved group observations in 13 semi-structured sessions and audio-recorded in-depth interviews with 11 leaders and 22 attendees. Of the attendees, 16 had experience of commercial clubs, 10 had experience of health service provisions and three had experience of groups that were neither health service nor commercial. One of the group leaders from the health service providers had attended a commercial slimming club, however none of the commercial club leaders had attended a health service session. The results of the study revealed that commercial club leaders had experience of weight loss particularly through their chosen brand, worked with paid or volunteer assistants and considered their club as their vocation. As such, they were able to directly relate to club members and empathise with their individual situations. In addition, commercial leaders were given standardised training provided by their head office, supported with on-going supervision. In contrast, the health service leaders ran the classes as part of their jobs with little assistance or administrative support; and one interviewee had received no prior training (Allan et al., 2011). One of the key differences between the programmes provided by the two groups is that the health service treatments were mainly fixed-term and therefore did not offer on-going support, whereas commercial slimming groups offered their participants the option of continuing their membership. In addition, the exposure and marketing of slimming club products and services is designed to create brand loyalty in the participants. The study showed that in both cases the element of support and supervision was one of the enabling factors in successfully changing dietary behaviour during and following the course of the programme.

4. Weight-loss programmes

In the UK, treatment for obesity is provided by the NHS, however the poor availability and effectiveness of these treatments have led to recommendations in the Government White Paper (Choosing Health, 2004) for the upgrading of services to include regular monitoring, physical activity, behavioural strategies and personalised dietary advice. Referral to commercial slimming clubs is one of the strategies employed by the NHS to expand the capacity of Primary Care Organisations to tackle obesity (Lavin, 2006).

The delivery of weight-loss programmes differs between the NHS/public health departments and commercial slimming clubs. The public health campaigns over the last few years in the UK have focussed on delivering information on dietary fat, sugar intake and the "eatwell plate". As such, the general population has been exposed to generic recommended guidelines for a balanced diet. However, despite the dissemination of nutrition information, obesity is still on the increase.

Commercial programmes use an approach that favours behavioural change rather than dissemination of knowledge to effect behavioural change and offer a combination of weight-loss programmes including some or all of the following; modest energy restriction, physical activity, behavioural strategy and long term follow up. In addition, their programmes often include structure, education, support, skills and strategies (Lavin et al., 2006). Currently, the three main commercial slimming clubs in the UK are Weight Watchers, Slimming World and Rosemary Conley Online and fitness franchises (formerly Rosemary Conley Diet and Fitness clubs). Although these clubs charge an attendance fee, membership is also available through GP prescription. The main features of each club are summarised in Table 3.

An observational study was carried out to independently audit the Weight Watchers NHS referral scheme in order to evaluate the effectiveness of the scheme (Ahern et al., 2011). The

study evaluated participants' weight losses retrospectively following attendance of 12 Weight Watchers sessions. Participants' body weights were measured by the Weight Watchers leader at the initial session, subsequent sessions and at the final session. Data from 29,236 out of 29,560 referral courses were included in the final analysis. However, as the final data was not normally distributed, medians and interquartile ranges of the data were statistically analysed using Stata/IC v. 10.1 software. The results showed that the median weight change for those completing all 12 sessions (n=11,851) was -5.4 kg (IQR: -7.8 to -3.1 kg) or 5.6% (IQR: -8.1% to -3.2%) of initial weight. The study demonstrated that a third of NHS referral patients who completed the 12-week course achieved ≥5% weight loss, which is considered to be the level at which clinical benefit is achieved (Ahern et al., 2011). Of note, was that the Ahern trial included participants who had undergone at least one previous referral.

Table 3. Main features of the three main slimming clubs in the UK*.

Commercial slimming club	Programme design and features
Weight Watchers	• The weight-loss programme is based on the POINTS® system where individuals are given a number of POINT values which are personal to them to use throughout the day. The programme is flexible as it is up to the individual how they spend their POINT values. • POINT values are based on the calories & saturated fat within a portion of food or drink. It is a simple system that helps members build a calorie deficit for healthy and sustainable weight loss and to follow a healthy diet that is low in saturated fat. • Learning and building healthy habits is an integral part of the programme with skills and strategies to help members change everyday habits and build activity into their lifestyle, so that they can lose weight and maintain their weight loss. • Small, achievable goals are encouraged, for example, a first weight loss goal of 5% of the individual's initial weight. • Meetings are weekly and weigh-ins are done in complete privacy. Confidentiality is guaranteed with no "naming and shaming". There is a weekly healthy weight loss curriculum so members can learn about healthy nutrition, activities and healthy habits in a supportive environment. • All group leaders have successfully lost weight through Weight Watchers themselves, so they understand the journey of weight loss. • The Weight Watchers POINTS system is also available to completely follow online at www.weightwatchers.co.uk.
Rosemary Coley Online (formerly Rosemary Conley Diet and Fitness Club)	• Members follow the F.A.B diet, with an optional booster diet called "solo slim", combined with an optional exercise programme adapted for individual fitness levels. These are all offered within an inclusive price. • The exercise class options depend on the instructor and are typically to music. • Weekly classes typically involve a private weigh-in and one-to-one consultation, followed by a 5-minute motivational talk and an optional 45-minute exercise session with a qualified instructor. • The programme promotes a healthy rate of weight loss and sets realistic weight-loss targets. • In addition to, or as an alternative to the classes, there are Rosemary Conley Diet and Fitness videos, books and magazine which people can follow at home, and an on-line version of the slimming club.
Slimming World	• Slimming World integrates the following three key principles to help slimmers adopt a healthier lifestyle: 1. A warm, empowering group environment which supports members and promotes behaviour change around eating and activity habits. 2. A satisfying eating plan to promote healthy eating patterns for life. 3. Activity management to help members gradually increase activity levels. • The healthy eating plan is called "Food Optimising" and is based on the principles of energy density and satiety. There are a number of food-choice options available so the plan is suitable to all members. • Fruit and vegetables can be eaten freely in all choices, so the 5-a-day recommendation is easy to achieve within this plan • Realistic weight-loss targets are encouraged (e.g. 10% weight loss) • Slimming World accepts pregnant and breastfeeding women with the support of their midwife or GP. • Slimming World also supports 11-15 year olds with a tailored programme called "Free2Go". This is free of charge when they attend with a parent or guardian.

* Data accessed from the British Dietetic Association (BDA) Commercial Slimming Organisations Summary

Weight lost during attendance at either commercial or NHS weight management programmes is generally not sustained once the participants leave (Truby et al., 2006) and long term

maintenance of weight loss is poor, with 50% of adults in the UK being found to regain weight within one year. Several factors interact to result in sustained weight loss. A combination of an energy restricted diet, exercise and behavioural therapy have been shown to be the most effective (Avenell et al., 2004).

Some studies have indicated that attendance at Weight Watchers can result in greater weight loss compared to self-help schemes. Although group member and leader incentives for good performance may contribute to the success of the programmes, elements such as advice for nutritional and behaviour change, the supportive environment of the groups and weigh-ins at the weekly sessions play a major part in their success (Lowe et al., 1999). Furthermore, a study to compare successful weight loss between self-help methods and membership of a Weight Watchers programme concluded that significantly greater weight loss was sustained over a six month period by participants attending the Weight Watchers classes and using the Weight Watchers interactive online and mobile tools than the self-help group (Johnston et al., 2013).

A randomised controlled trial of four commercial weight-loss programmes in the UK followed the participants over a 12 month period to compare the effectiveness of the different diets. Two of the diets, Weight Watchers Pure Points and Rosemary Conley's Eat Yourself Slim plan were group based, and the other two diets, Dr Atkins' new diet revolution and the Slim-Fast plan, were self-managed. A significant loss of body fat and weight was reported for all diets against the control group at a six month period. A total of 54% of participants returned data at the 12 month follow up of which 19% had switched diets and 36% were following their own diet or exercise plans. More participants were lost from the self-managed diets and the results showed that participants' behaviour between six and twelve months pointed to an advantage in group support based programmes.

A meta-analysis carried out to assess the effectiveness of dietary counselling as a method to minimise weight gained at follow-up concluded that further studies were necessary to establish which factors resulted in the most effective weight loss (Dansinger et al., 2011).

Commercial weight management companies are increasingly providing internet based products and support to their members as demand for this service is predicted to grow (Mintel, 2013). The main three providers have an online service, Weightwatchers has an app (Weight Watchers eTools) and Tesco launched its health and wellbeing app in December 2013, a free service from Tesco diets. A mixed methods study carried out on social support in an internet weight loss community, used surveys and questionnaires to collect data on the user demographic and clinical characteristics and the usage of the internet for social support. The themes that were identified in the community of users of the selected online service were encouragement and motivation, information and shared experiences which are similar to face-to-face peer social support (Hwang, 2010). Interestingly, the comments from the qualitative analysis included messages about accountability, so even though members were not attending weighing in sessions, information on weight loss would be shared and supported by the community. A consequence of this was the subsequent recognition and congratulation for those who achieved weight loss and support and encouragement for those who were struggling. Information was important for 58.5% of the respondents but there was no clarification on whether the information sought was from fellow dieters or from health care and weight management professionals.

5. Conclusion

The knowledge, attitude and behaviour relationship is a complex one. Although previous studies have found a high level of nutrition knowledge in the overweight and obese

population, research indicates that the level of knowledge, whether procedural or declarative, is weakly associated with dietary behaviour.

Self-help methods for weight loss, such as the use of food diaries and food monitoring apps are widely used, however commercial slimming clubs have higher success rates. In both cases, weight loss is rarely sustained following dieting programmes (Truby et al., 2006) and clients of commercial slimming clubs often include a large proportion of persistent dieters who have failed to prevent weight gain after successfully losing weight in the past.

Research has demonstrated that there is an important distinction between dissemination of information and educational methods that encourage behavioural change. Further research is required to determine whether nutrition knowledge gained through commercial weight-loss programs is effective in modifying dietary behaviour or whether other strategies offered by slimming clubs have greater influences. This will be the subject of a questionnaire-based research project by the author.

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Is there a relationship between nutrition knowledge and dietary behaviour patterns in members of commercial slimming clubs in Greater Manchester?

Keywords: Obesity; Weight loss; Education; Public Health

Appropriate journal

The choice of journal depends on the subject, target readership and study type. “Nutrition & Food Science” (NFS) and “Public Health Nutrition” (PHN) were both considered suitable for this report (impact factors: 3.48 and 2.25, respectively; 2012).

- NFS reports on attitudes to food and nutrition and healthy eating/nutritional public health initiatives/policies through applied research, case studies and meta-analyses.
- PHN aims to promote good health in the population through nutrition and practical solutions to public health problems, including the effectiveness of intervention studies.

Based on these criteria, PHN was considered the most suitable journal for this study.

Abstract

Objective: To establish whether there is a relationship between nutrition knowledge and dietary behaviour in members of commercial slimming clubs.

Design: A self-completed questionnaire on nutrition knowledge, dietary behaviour and factors associated with weight-loss management.

Setting: Members of slimming clubs in their home environment.

Subjects: The targeted sample comprised of 56 members of slimming clubs in the Greater Manchester area recruited through social media and the local Rosemary Conley slimming club leader.

*Results: The level of nutrition knowledge in the study population was high, however this was not significantly correlated with dietary behaviour which was poor (*r=0.054; p=.694*). Similarly, nutrition knowledge and dietary behaviour were not significantly correlated with education levels, age or alcohol consumption (p>.05). However, a significant inverse relationship was found between educational attainment and BMI* (r=-0.392, p=.005)*. Barriers to weight loss were not reported to be major factors by this study group; the greatest benefits of membership were support and encouragement from other members and the club leader. The proportion of returning members was >70%.*

Conclusions: Dietary behaviour in members of commercial slimming clubs is not significantly influenced by nutrition knowledge. Although healthy eating recommendations can be valuable, other factors are more important for achieving weight loss, particularly support and fellowship from other members. Slimming club members regain the weight lost after leaving the clubs and inevitably re-join.

1. Introduction

Obesity (defined as BMI ≥25 kg/m^2) and its associated health risks are an increasing problem in Britain (Ahern et al., 2011). In Salford, part of Greater Manchester, the percentages of overweight and obese people are 36.3% and 27.0%, respectively (Public Health England, 2014), and is a key concern for the public health team. Various programmes are run to inform people about diet and encourage weight loss: Between 2010–2013, Manchester City Council introduced a healthy weight strategy to tackle these issues in the local population, particularly those most at risk of obesity, including low income families, children with at least one obese parent, single parents and older people (Manchester's Healthy Weight Strategy, 2010-2013); the main commercial slimming clubs actively recruit in the area. The clubs promote participatory weight loss activities, and members can meet and gain support from people in similar situations. There is considerable research in determining the effectiveness of the NHS and commercial approaches, particularly the role of nutrition knowledge and whether this translates to improved dietary behaviour (e.g. Worsley, 2002).

1.2. Study aims

- The principal aim of this study was to establish whether there was a relationship between nutrition knowledge and dietary behaviour in targeted population of adult members of slimming clubs in the Greater Manchester area by investigating the level of nutrition knowledge in relation to BMI and demographic characteristics in this population.
- The secondary aims were to identify the key barriers to weight loss and the reasons why the participants chose slimming clubs as a means to lose weight.

2. Methods

2.2. Study design

The primary purpose of this questionnaire-based study was to investigate whether there is a relationship between nutrition knowledge (independent variable) and dietary behaviour (dependent variable) in the sample population. Additional contributory factors were explored, including the greatest barriers to weight loss experienced by the participants and the main reasons for and benefits in their choice of commercial slimming clubs.

Data was obtained from volunteer participants *via* a printed or online questionnaire. The printed questionnaires were distributed to an organiser of local slimming clubs and collected four weeks later; the online questionnaire was completed through the SurveyMonkey website (www.surveymonkey.com). It was publicised through Facebook, Twitter and LinkedIn and the link was emailed to local businesses, Salford City Council and doctors' surgeries (Appendix 1 & 2).

This study was conducted according to the guidelines laid down in the declaration of Helsinki and all procedures involving human subjects were approved by the Faculty of Life Sciences Research Ethics Committee of the University of Chester (Appendix 3). Informed consent was from all subjects at the point of questionnaire distribution or logging onto the survey website. All participants were offered access to the final results of the study.

2.3. Participants

Participants were all members of commercial slimming clubs in Greater Manchester (Weight Watchers, Slimming World, Juliesweigh2fitness (formerly a franchise of Rosemary Conley Diet and Fitness), LighterLife) and were recruited by contacting the club organisers or through advertisements on local community notice boards or through social networking sites. The

initial aim was to enrol a minimum of 52 eligible participants (with ~26 per group) so that any significant effects could be statistically identified between groups. All participants were over 18 years of age and were recruited irrespective of weight or gender. Each participant was also asked to provide demographic and weight/height data. All questions were voluntary (Appendix 4).

2.4. Questionnaire design

The survey questions were compiled from established nutrition knowledge questionnaires (NKQs) that had been used and validated in previous studies targeting the general population or overweight subjects (Appendix 4). The justification for each question and the reason for its inclusion are described in Appendix 5.

The questions were divided into categories and scored as follows:

(1) Nutrition knowledge: this consisted of 25 questions, split approximately equally between declarative (factual knowledge) and procedural knowledge (knowing how) questions. One point awarded for every correct answer and zero for each incorrect answer.

(2) Dietary behaviour: the three questions were scored on a scale (1-5); a low total score (minimum: 3) equated to poor dietary behaviour; a high total score (maximum: 15) equated to good dietary behaviour. The subsection on alcohol consumption was scored by calculating the total number of units alcohol consumed per week using the NHS "alcohol unit calculator" (www.nhs.uk/Tools/Pages/Alcohol-unit-calculator.aspx).

(3) Barriers to weight loss: the seven questions in this section were also scored on a scale, with 1 point for a minor/irrelevant barrier and 5 points for a major barrier. A high score was considered a potential contributor to poor dietary behaviour.

(4) Slimming club criteria: an open-ended question relating to the benefits of the chosen slimming club membership

(5) Participant's demographics and weight/height data: this included questions on gender, ethnicity, age, education and weight/height data from which the participant's BMI was calculated.

The scoring systems are detailed in Appendix 6.

2.5. Data analyses

The raw data was either entered into a Microsoft Excel worksheet from the printed questionnaires or imported from the Survey Monkey website. The scores for nutrition knowledge, dietary behaviour, barriers to weight loss, alcohol consumption and BMI were then compiled before being transferred to the SPSS v. 21 software program for statistical analysis. As the sample size was <100, the Shapiro-Wilks test was conducted to test for distribution of normality. The results showed the data was not normally distributed, therefore Spearman's Rank Correlation was performed to identify correlations between nutrition knowledge (independent variable) and the other tested variables. A value of $p<.05$ was considered statistically significant.

In order to perform between-test comparisons between the different slimming club groups with a power of 80% and alpha set at .05, a minimum of 26 participants/club would have been required for two-sided t-tests (Cohen & Holliday, 1996). As only one club recruited >26 eligible

participants (Slimming World) the responses from all the clubs were amalgamated prior to the correction analyses (Appendix 6D).

For the free-text section of the questionnaire, the responses were grouped into categories. Each response was counted as one and the categories were ranked according to total score. Example statements were taken from the highest scoring categories.

3. Results

3.2. Participants' characteristics and represented commercial slimming clubs

A total of 64 participants completed and returned the nutrition knowledge questionnaire (NKQ), of which 56 satisfied the selection criteria for the analyses. The participants' age, gender, ethnicity and BMI's are summarised in Table 1; the complete dataset is provided on a memory stick given to the Department of Clinical Sciences and Nutrition at the University of Chester.

- The following commercial slimming clubs were represented: Slimming World, Weight Watchers, Juliesweigh2fitness (formerly a franchise of Rosemary Conley Diet and Fitness), LighterLife and a local fitness club.
- The total sample comprised of 91% (51/56) women and one (2%) man. Four (7%) participants opted not to complete the personal data section.
- The participants were aged between 18 and 74 years old; the median age-range was 35–44. The 18–34 age range had the highest representation 43% (24/52).
- The participants' ethnicities were predominantly white 91% (51/52).
- The sample included 31% (16/50) obese members (BMI ≥30 kg/m^2) and 35% (18/50) overweight members (BMI ≥25 kg/m^2).

Table 1. Participants' characteristics

Characteristics	n	%
Gender:		(n=56*)
Female	51	91%
Male	1	2%
unspecified	4	7%
Age range:		(n=52)
18-34	24	46
35-44	13	25
45-54	6	12
55-74	9	17
Ethnicity:		(n=52)
white	51	98
Black	0	0
other	1	2
BMI category:		(n=50)
obese (≥30 kg/m^2)	16	31
overweight (≥25 kg/m^2)	18	34
not overweight (<25 kg/m^2)	16	31
not-specified	2	4

*All 56 eligible participants completed the nutrition knowledge sections; 52 completed all of the sections with the exception of BMI where two participants chose not to disclose their details.

3.3. Questionnaire responses

The nutrition knowledge section of the questionnaire was completed by all 56 eligible participants. Only 52 returned responses to all the main sections, with four participants choosing to omit certain sections, and 50 provided weight/height data. There was a similar percentage of >80% correct answers to the declarative and procedural knowledge questions within the nutrition knowledge section (46% and 42% respectively).

Between 60% and 88% of all participants correctly understood that reducing the diet by 500 kcal/day would result in a weight loss of 1-2 lb/week. However, the majority of participants returned incorrect answers to questions relating to nutrient types: for example, the number of kcals equivalent to a pound of body fat; the amount of sugar in Cola; and which foods do not contain carbohydrates.

3.4. Levels of nutrition knowledge and dietary behaviour

The participants' individual nutrition knowledge and dietary behaviour scores are listed in Appendix 6D and E. The scores were categorised into groups, ranging from low/poor to high/good (Table 2).

The results demonstrated that the level of nutrition knowledge in the study sample was generally high: 52% (n=29) of participants scored between 15–20; and 25% (n=14) had a score ≥20 (Table 2). The median score was 17/25 (68%).

In contrast, the level of dietary behaviour was poor: although the median score was 60% (9/15), 65% of participants scored ≤9 points (Table 2).

Table 2. The levels of nutrition knowledge and dietary behaviour in members of commercial slimming clubs in Greater Manchester based on questionnaire scores.

(A) Nutrition knowledge

Level	Score (0-25)	No of participants	% (n=56)
v. high	≥20	14	25
high	≥15 <20	29	52
medium	≥10 <15	12	21
low	≥5 < 10	1	2
v. low	<5	0	0

(B) Dietary behaviour

Level	Score (3-15)	No of participants	% (n=55)
v. good	14-15	2	4
good	11-13	13	24
medium	10	4	7
poor	7-9	22	40
v. poor	4-6	14	25

*All 56 eligible participants completed the nutrition knowledge sections; one of the participants omitted the dietary behaviour section.

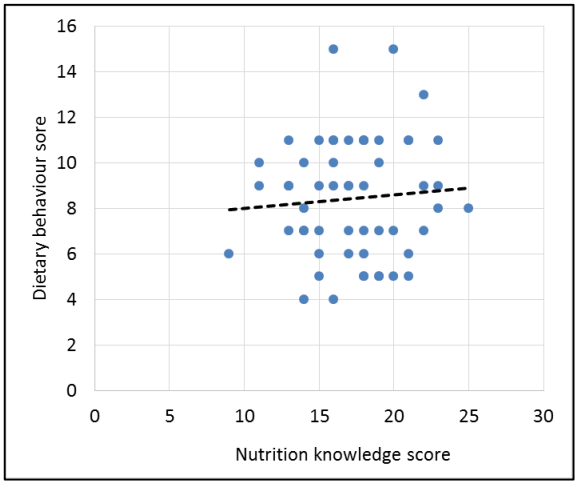
3.5. Correlation between nutrition knowledge and dietary behaviour

The results showed that nutrition knowledge was not correlated with dietary behaviour in this study population (r=0.054). However, this relationship could not be verified as the significance of correlation gave a p-value >0.05 (p=0.694; Figure 1A).

3.6. Correlations between nutrition knowledge, BMI and alcohol consumption

No significant relationships were found between nutrition knowledge and alcohol consumption (r=0.081, p=0.576; Figure 1B). Although the analysis indicated an inverse correlation between nutrition knowledge and BMI (r=-0.180; p=0.211; Figure 1C), the result was not significant and so could not be accepted with high confidence.

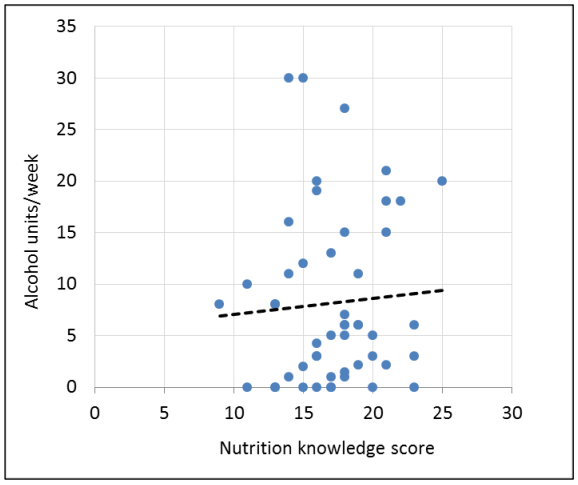
A)



Dietary behaviour

r = 0.054
p = 0.694

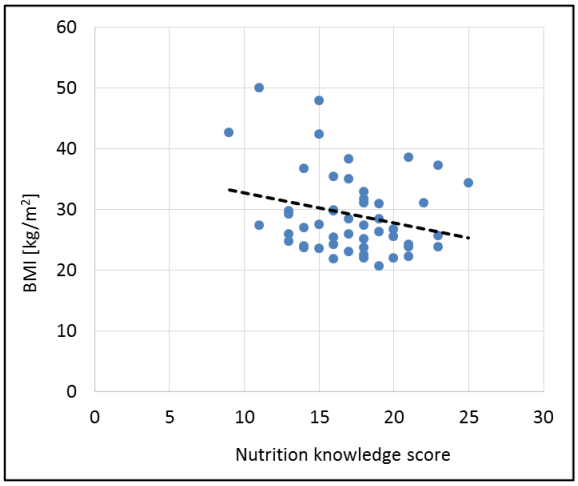
B)



Alcohol intake

r = 0.081
p = 0.576

C)



BMI

r = -0.180
p = 0.211

Figure 1. Correlation analyses of nutrition knowledge versus **(A)** dietary behaviour; **(B)** alcohol intake; and **(C)** BMI in members of commercial slimming clubs in Greater Manchester. These demonstrate that the dietary behaviour and alcohol consumption of the study sample was not significantly influenced by their nutrition knowledge. Although there was a negative correlation between nutrition knowledge and BMI, this again was not significant. [Spearman's rank correlation.]

3.7. Relationships between education, nutrition knowledge and BMI values

In order to explore the relationships between education levels and age with nutrition knowledge and dietary behaviour, the participants were grouped according to educational attainment as follows: secondary, higher, and degree/post graduate (Table 3). Weight-related and demographic characteristics were assessed within each group. The results revealed that over half (54%) of the participants had completed a degree or postgraduate education, and a further 21% had completed higher education. These were primarily in the younger age range (18-34 years), whereas those that had received secondary education only were mainly in the higher age range (55-74 years). The sample size within each educational group was too small to run between-groups tests, however participants in all three groups showed similar levels of nutrition knowledge (17-18 points) and dietary behaviour (8-9 points). A slight trend suggesting that higher educational attainment may lead to a lower BMI (from 31.5 to 27.2 kg/m^2); this was supported by the subsequent correlation analyses (Figure 2B).

Table 3. The relationships between participants' education levels and their nutrition knowledge, dietary behaviour and demographic characteristics.

	Secondary education [O'Level and GCSE]	*Higher Education [A Level, Diploma or equivalent]*	*Degree or postgraduate*
No. respondents (%, n=52)	13 (25%)	11 (21%)	28 (54%)
modal age range (years)	55-74	18-34	18-34
mean BMI (kg/m^2)	31.5 (SD ±1.88)	29.1 (SD ±1.84)	27.2 (SD ±2.07)
nutrition knowledge score [median]	17	17	18
dietary behaviour score [median]	8	9	9

The results showed that the participants' education levels had no significant influence on their nutrition knowledge (r=0.028; p=0.845; Figure 2A). In contrast, the analyses revealed a significant inverse relationship between their educational level their BMIs (r=-0.392, p=0.005; Figure 2B). No significant correlations were observed between the participants' ages and their nutritional knowledge (r=0.06; p=0.670; Figure 2C) or their BMIs (r=-0.057, p=0.694; Figure 2D).

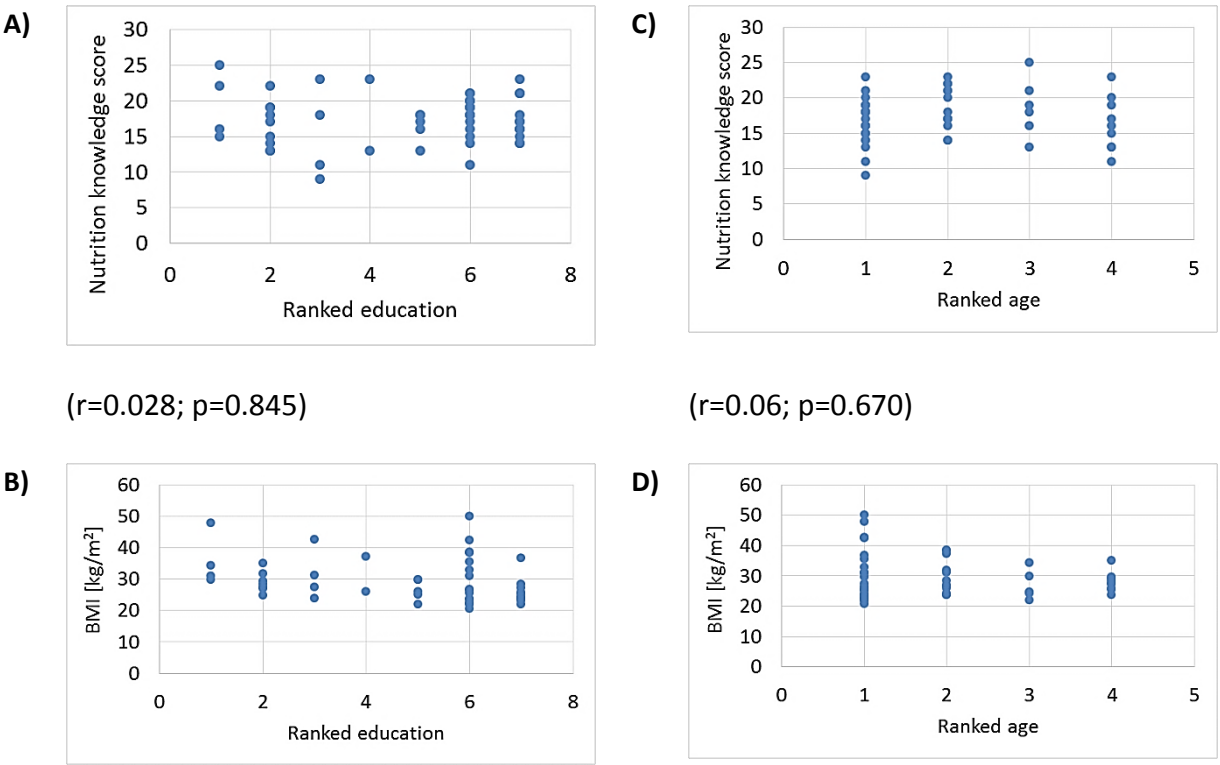


Figure 2. Correlation analyses BMI in members of slimming clubs in Greater Manchester: **(A & B)** between their educational levels, nutrition knowledge and BMIs, respectively; **(C & D)** and between their ages, nutrition knowledge and BMIs, respectively. [Spearman's rank correlation]. Age and education ranks in Appendix 6F and 6G.

3.8. Barriers to weight loss and benefits of commercial slimming clubs

The participants were asked to rate the factors they found to be the greatest barriers to weight loss (on a scale from 1–5). A total of 127 responses were identified as significant barriers to weight loss by the whole study group (score ≥4). These were listed in hierarchical order according to the number of respondents (Appendix 7A). The results indicated that the greatest barriers to weight loss experienced by the participants were controlling cravings, controlling what to eat when they were hungry, and estimating portion sizes. The availability

of healthy food choices at the times and places where they ate was also cited as a barrier to weight loss**.**

The participants also had the option of giving free-text responses on the services offered by their slimming club that they found most beneficial for achieving weight loss. Similar responses were grouped into categories and these were ranked in hierarchical order (Appendix 7B). The total number of most-cited responses was 88 from 51 participants. The results revealed that the participants found support from the club leader and other club members (n=20) were the greatest help to weight loss. Participants' comments on support included: "Support from leader & other members & something to aim for each week" and "The support from my group specifically is enormous, people sharing their experiences inspires me".

Education and advice (n=16) was also cited as being an important benefit, along with fellowship (n=10) and encouragement (n=9). The comments relating to education and advice centred on nutrition talks, and recipes and tips on healthy eating, such as "Information on food types & meal ideas". Although these findings suggested that practical application nutrition knowledge was useful to weight loss, the earlier correlation analyses had demonstrated that this had had no significant effect on dietary behaviour.

Group sport activities and advice and information about sport were only cited as key benefits by members of the Rosemary Conley and Juliesweigh2fitness clubs (n=9).

Keeping a food diary may facilitate changing dietary patterns, however only 45% of the participants (n=25/56) admitted to keeping a food diary. It is unclear whether this was an activity encouraged by the slimming clubs.

3.9. Dietary behaviour outcomes and persistent dieters

At the time the questionnaire, only nine (16%) of the 55 participants agreed that they had made a significant change in their dietary behaviour during membership of their slimming club, and fewer than half the participants (42%; n=23) believed they had successfully made changes which they were trying to maintain.

Almost three-quarters of the participants (n=37/52; 71%) admitted to having been a member of a slimming club at least once before (either the same or another club). Although the specific reasons weren't given, this is frequently due to failure to maintain previous weight-loss attempts. The study group would probably have included NHS referrals, however this data remains confidential and was not available to this study.

4. Discussion

In 2011, a quarter of the UK population were classed as obese (BMI ≥30 kg/m^2) or overweight (BMI ≥25 kg/m^2) (Ahern et al., 2011). Furthermore, it has been predicted that obesity could increase to 60% of adult men, 50% of adult women and around 25% of children under 16 in Britain by 2050 (The Foresight obesity project; Butland et al., 2007). However, the NHS has insufficient capacity to deliver the required scale of weight loss programmes alone and often refers patients to commercial slimming clubs (Lavin, 2006). The causes of obesity are complex and dietary and physical habits are influenced by an individual's knowledge and attitudes as well as their socio-economic environment (Turrell & Kavanagh, 2005). The Knowledge-Attitude-Behaviour model has proposed that accumulation of knowledge can lead to a gradual change in behaviour by initiating a change in attitude (Baranowski et al., 2003).

The main purpose of this study was to contribute to current research on methods of targeting obesity. The focus of this particular study was to identify the relationships between nutrition knowledge and dietary behaviour in members of commercial slimming clubs in Greater Manchester. The roles of other weight-related factors were also investigated, including demographic characteristics, barriers to weight loss and the services and approaches provided by the slimming clubs.

The study population was mostly female and the ethnicity was predominantly white. Although, this was not representative of the general population of Greater Manchester (in 2012, the proportion of females was 50.5% and the ethnicity was 83.7% white; ONS, 2012), it was considered typical of slimming club membership in this area: recent reports have shown that more men are overweight or obese in the UK than women, however they are less likely to seek interventions to lose weight (Robertson et al., 2014). The higher proportion of white participants in the study sample may have reflected the clubs being located in more ethnically white areas or a lower engagement of non-whites with commercial slimming clubs. This bias may have been amplified by the small size of the study population (n=56). The percentages of overweight and obese participants were 36% and 32%, respectively, which was similar to the general population in the Salford area of Greater Manchester (36.3% and 27.0%, respectively) (Public Health England, 2014).

The level of nutrition knowledge within the study population was found to be high, with 52% of participants achieving scores of 60%-80%. This was in line with previous studies showing that obese individuals often possess high levels of nutrition knowledge (O'Brien & Davies, 2007). However, this did not significantly correlate with dietary behaviour ($r=0.054$; $p=0.694$) with 65% of the participants returning scores below 60%. These findings supported previous

research which has shown that nutrition knowledge is weakly correlated with dietary behaviour (Worsley, 2002).

The education level of the study population was also high, with the majority of participants having completed higher or degree/postgraduate education (21% and 54%, respectively) compared to those with secondary education alone (25%). Although the sample size within each education group was too small to run a between-groups test, the scores for nutrition knowledge and dietary behaviour were similar across all three groups (17-18 and 8-9 points, respectively). The participants' BMIs showed a slight tendency to be inversely correlated with education attainment (from 31.5-27.2 kg/m^2) suggesting that educational attainment might lead to improved dietary behaviour; this was further backed-up by the correlation analysis with showed a strong inverse relationship between these two factors.

It was not possible to ascertain whether the participants' levels of nutrition knowledge or dietary behaviour had improved as a result of joining a slimming club as there were no baseline or control group data to allow quantifiable comparisons.

The social cognitive theory (Roberts et al., 2011) suggests that social and environmental factors can impact on behaviour. For example, educational achievement can lead to increased income and purchasing power; so although a high level of education has been positively correlated with an increased level of nutrition knowledge, purchasing power has been shown to have a greater impact on dietary behaviour than nutrition knowledge (Turrell & Kavanagh, 2005). A further study on dietary behaviour in relation to socio-economic position (SEP) found that education was negatively correlated with high-sugar intake in German women (Finger et al., 2013).

Procedural knowledge ('knowing how' to perform a specific action) has been proposed as playing a greater role in dietary behaviour than declarative knowledge ('knowing that' or

factual knowledge). For example knowing the fibre content of fruit (declarative knowledge) may not have the desired outcome in selecting a healthier snack (procedural knowledge) (Dickson-Spillman, 2011).

Public health campaigns have often favoured the dissemination of knowledge as a means of influencing the types of foods people eat; for example, the "eatwell plate", “5-a-day”, and fat and sugar intakes. However, evidence has shown that this has not significantly influenced weight loss in target populations (Wardle, Parmenter and Waller, 2000). A high BMI may be an indicator of negative dietary behaviour. A study investigating the relationship between nutrition knowledge and BMI in a sample of 145 adults found that although the subjects knew what they should be eating, this had no significant impact on their BMI levels (O’Brien & Davies, 2006).

In contrast, educational techniques or interventions that encourage behavioural change (e.g. interactive, varied and fun) have been shown to have a greater impact in promoting positive dietary outcome than dissemination of information alone (e.g. Indian schoolchildren study; Shah et al., 2010). Behavioural intervention is favoured by commercial slimming clubs through programmes that not only advocate energy restriction but offer tools and advice to encourage nutritional and behavioural change in a supportive environment (Lowe et al., 1999).

A high level of alcohol consumption may reflect poor dietary behaviour. The very weak correlation observed between nutrition knowledge and dietary behaviour in the study population was reflected by the results on alcohol intake ($r=0.081$, $p=0.576$). The Framlingham cohort study (Gordon & Kannel, 1983) found that men who drank alcohol at baseline had higher bodyweights at the 20 year follow-up compared to non-drinkers.

It has been hypothesised that environmental factors and the increasing obesogenic elements of peoples’ lives are key driving forces in the obesity epidemic (Swinburn et al., 2004). Many

of these elements act as barriers to weight loss irrespective of a person's nutrition knowledge. Commercial slimming clubs adopt approaches that target external influences that act as barriers to weight loss. The results of this study failed to show a significant correlation between nutrition knowledge and barriers to weight loss in the sample ($r=-0.125$; $p=0.508$), therefore inferences could not be drawn to support or challenge the main hypothesis. Furthermore, the majority of the participants reported that most of the barriers to weight loss presented in this study were not being major obstacles. Those that were rated as being the greatest barriers were management of food cravings and controlling what to eat when hungry.

Various other factors may play greater roles than nutrition knowledge in modifying dietary behaviour, as demonstrated by the participants' responses: these indicated that many of the participants were also looking for support and fellowship. This was in agreement with previous reports that found the positive effects of dieting can be attributed more to the social support than to the diet itself (Thomas et al., 2008). Similar findings were reported in a study of internet-based slimming clubs in which the participants cited encouragement and motivation (87.0%), information (58.5%) and shared experiences (42.5%) as the factors that were the greatest benefits to weight loss (Hwang et al., 2010). All the clubs in this study recommended exercise programs; however, these were only reported as beneficial by members of JuliesWeigh2Fitness/Rosemary Conley Diet and Fitness, suggesting that exercise may have had a higher emphasis in these two clubs.

Weight-loss maintenance is associated with an immediate initial weight loss, an active lifestyle, weight related behaviours that are self-monitored, and regular food intake patterns that include eating breakfast and eating healthily (Kruger et al., 2006). The use of behavioural modification to increase physical activity and reduce calorie intake is also recommended for

successful weight loss. In contrast, poor body image and high levels of external and emotional eating have been perceived as barriers to exercise and dietary change and a negative predictor of weight-loss maintenance (Teixiera et al., 2010).

Whilst there is evidence that interventions based on behavioural change (body acceptance, and eating behaviour), social support and exercise improves self-esteem: obese people still rely on 'quick fix' diet methods which have a short term effect (Ikeda et al., 2004).

In general, commercial slimming clubs have demonstrated higher success rates through their weight-loss programs than NHS programs (Jebb et al., 2011). However, weight loss is rarely sustained once participants leave a dieting program, irrespective of the program provider (Truby et al., 2006). As a result, clients of commercial slimming clubs include both returning dieters who have failed to maintain previous weight loss and referrals from NHS programmes (Lavin et al., 2006). The main reason for NHS referrals is the limited capacity of the NHS to tackle the increasing scale of the obesity epidemic. Where cost is not a prohibitive factor, members of commercial slimming clubs often maintain their membership after achieving their weight-loss goals or return as they inevitably regain some or all of the weight lost during the initial diet plans. A total of 36/50 (72%) participants stated they had been members of one or more slimming club previously.

In summary, successful weight loss is possible through both NHS/public health run programmes and commercial slimming clubs. The most sustainable benefit that participants receive from the commercial slimming clubs is the social support of the group; a secondary benefit is behavioural-change advice on how to integrate new healthy habits into their lifestyle.

5. Limitations of the study and directions for future investigation

The key limitations of this study were the time constraints of the project and the small study population. Consequently, there were no baseline or follow up data, meaning the study could only provide a "snapshot" of the participants' nutrition knowledge and dietary behaviour patterns; and the sample sizes were too small to allow between-group comparisons. Both these are key areas for future investigations. Other areas for future investigations include identifying which interventions are the most successful for long-term maintenance of weight loss and whether the focus should be on health indicators and wellbeing instead of weight loss. Also unknown, principally due to patient confidentiality, was the proportion of NHS referrals in the study sample.

6. Conclusions

The knowledge-attitude-behaviour model often does not apply in the field of weight loss due to the complexities of the interactions and external factors. In line with this conclusion, this study showed there was no correlation between nutrition knowledge and dietary behaviour among members of slimming clubs in Greater Manchester. The qualitative findings of this study indicated that services offered by commercial slimming clubs were more relevant to the members' lifestyles and were more effective than simple dissemination of information, particularly in overcoming barriers to weight loss. The support of other club members was also a key factor in facilitating weight loss. Membership of slimming clubs is generally short-term; the findings of this study suggested that longer-term strategies, such as on-going support to reinforce weight-loss techniques and counselling, may facilitate sustained weight loss. Given the increasing scale of obesity in Britain, the associated health-care costs and the low treatment capacity of current public health programs, the outcomes of this study may

help direct future investigations in targeting these issues. However, further research is necessary using larger study populations and follow-up analyses.

Acknowledgements

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Appendices

Appendix 1 Recruitment advertisement

University of Chester

Participants Wanted

Are you aged 18 or over? Are you currently dieting with a slimming club? Are you interested in finding out what you know about food and your eating habits?

If the answer to these questions is yes then why not take part in an MSc student's scientific research and help further the cause of good dietary habits.

There will be no cost to you and you do not need to attend any sessions; the questionnaire can be completed on paper and handed to participating clubs or submitted on-line.

For further info please send an email quoting 'YES' to

1324743@chester.ac.uk.

Thank you for your interest in this research.

Appendix 2 Participant information sheet

Participant information sheet

The Relationship between nutritional knowledge and dietary behaviour

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

What is the purpose of the study?

This research is being undertaken on members of slimming clubs to establish how much influence nutritional knowledge has on the dietary behaviour.

Why have I been chosen?

You have been chosen because you are a member of a commercial slimming club.

Do I have to take part?

It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect you in any way.

What will happen to me if I take part?

You will complete a paper or online questionnaire to assess your nutritional knowledge and dietary behaviour. No-one will be identifiable in the final report.

What are the possible disadvantages and risks of taking part?

There are no disadvantages or risks foreseen in taking part in the study.

What are the possible benefits of taking part?

You may learn new information about healthy eating. The questionnaire may also identify areas in your behaviour that you had not considered as obstructive to weight loss and wellbeing.

What if something goes wrong?

If you wish to complain or have any concerns about any aspect of the way you have been approached or treated during the course of this study, please contact Professor Sarah Andrew,

Dean of the Faculty of Life Sciences, University of Chester, Parkgate Road, Chester, CH1 4BJ, 01244 513055.

Will my taking part in the study be kept confidential?

All information which is collected about you during the course of the research will be kept strictly confidential so that only the researcher carrying out the research will have access to such information.

What will happen to the results of the research study?

The results will be written up into a report for the final project of my MSc. Individuals who participate will not be identified in any subsequent report or publication.

Who is organising the research?

The research is conducted as part of an MSc in Human Nutrition within the Department of Clinical Sciences and Nutrition at the University of Chester. The study is organised with supervision from the department, by Barbara Bray, an MSc student.

Who may I contact for further information?

If you would like more information about the research before you decide whether or not you would be willing to take part, please contact:

Barbara Bray 1324743@chester.ac.uk.

Thank you for your interest in this research.

Appendix 3 Ethics approval letter

University of Chester

Faculty of Life Sciences
Research Ethics Committee

frec@chester.ac.uk

Barbara Bray
Folly Lane
Manchester

5th June 2014

Dear Barbara,

Study title: **Nutritional Awareness of Members of Slimming Clubs in Greater Manchester.**
FREC reference: **911/14/BB/CSN**
Version number: **1**

Thank you for sending your application to the Faculty of Life Sciences Research Ethics Committee for review.

I am pleased to confirm ethical approval for the above research, provided that you comply with the conditions set out in the attached document, and adhere to the processes described in your application form and supporting documentation.

The final list of documents reviewed and approved by the Committee is as follows:

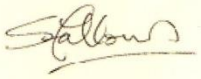
Document	Version	Date
Application Form	1	April 2014
Appendix 1 – List of References	1	April 2014
Appendix 2 – C.V. for Lead Researcher	1	April 2014
Appendix 3 – Participant Information Sheet	1	April 2014
Appendix 4 – Correspondence with Slimming Club Organiser	1	April 2014
Appendix 5 – Questionnaire	1	April 2014
Appendix 6 – Questionnaire Planner	1	April 2014
Appendix 7 – Recruitment Advertisement	1	April 2014
Appendix 8 – Web survey cover letter	1	April 2014
Response to FREC request for further information or clarification		May 2014
Appendix 1 – List of References	2	May 2014
Appendix 5 – Questionnaire	2	May 2014

Approval letter – 2013/14

Please note that this approval is given in accordance with the requirements of English law only. For research taking place wholly or partly within other jurisdictions (including Wales, Scotland and Northern Ireland), you should seek further advice from the Committee Chair / Secretary or the Research and Knowledge Transfer Office and may need additional approval from the appropriate agencies in the country (or countries) in which the research will take place.

With the Committee's best wishes for the success of this project.

Yours sincerely,



Dr. Stephen Fallows
Chair, Faculty Research Ethics Committee

Enclosures: Standard conditions of approval.

Cc. Supervisor/FREC Representative

Appendix 4 Nutrition knowledge questionnaire

The Relationship Between Nutritional Knowledge and Dietary Behaviour

This questionnaire is not a test. The answers will be used to help identify the level of nutritional knowledge amongst members of slimming clubs and establish whether there is a link between nutritional knowledge and dietary behaviour.

The questionnaire will take about 30 minutes to complete. It is important to answer the questions as honestly and accurately as possible. Please complete the questionnaire by yourself.

Answer each question with a tick, a circle or by writing down the answer if applicable.

Your answers will be anonymous and will only be seen by the researcher and the staff at the University of Chester, Department of Clinical Sciences and Nutrition.

If you would like a copy of the final results to be sent to you, then please include your email address in the box provided at the end of the questionnaire.

Barbara Bray

1324743@chester.ac.uk

Questions 1 – 25: Nutritional Knowledge

Please circle your answers

No	Question	Answer options
1	Brown sugar is much healthier than white sugar.	True False
2	Equal amounts of beef steak and chicken breast contain the same number of calories.	True False
3	Oily fish (salmon/mackerel) contains more healthy fats than red meat.	True False
4	Bacon contains more calories than ham.	True False
5	Vitamins and minerals give you the same amount of calories as carbohydrates and proteins.	True False
6	A food that is labelled ”low-fat” always has less calories than the regular version of that food.	True False
7	The first ingredient listed in the ingredients on a food label is always the one with the highest weight.	True False
8	To eat healthily, you should eat less fat. It doesn’t matter whether you also eat less fruit and vegetables.	True False
9	A salad dressing made with mayonnaise is as healthy as the same dressing made with mustard.	True False
10	If you decreased your food intake by 500 calories per day, how many pounds would you expect to lose in a week?	1–2 2–3 3–4 4–5 5–6
11	How many cubes of sugar are in 500ml of Coca-Cola?	5 15 25 40
12	Which of these foods does not contain carbohydrates?	Apple Hamburger Coke Milk Peas
13	A pound of body fat is the equivalent of ? kcal	500 1500 2500

		3500 4500
14	Which of these types of strawberry jam do you think is the healthiest, based on the lists of ingredients?	• ***Strawberry jam:*** Sugar, strawberry, water, citric acid, pectin and potassium sorbate (40 g berries per 100 g of jam) • ***Strawberry jam without additives:*** Strawberry, sugar, water, citric acid and pectin (46 g berries per 100 g of jam) • ***Strawberry jam, homemade type:*** Strawberry, sugar, water, pectin, malic acid and potassium sorbate (60 g berries per 100 g of jam)
15	Which of these plates of rice, chicken fillet and vegetables do you think is the healthiest choice?	**Plate 1**  **Plate 2**  **Plate 3** 

Please tick one of the options for each answer

16	Which of these would be the best choice for a low fat, high fibre snack?	(a) diet strawberry yoghurt (b) raisins (c) muesli bar (d) wholemeal crackers and cheddar cheese
17	Which of these would be the best choice for a low fat, high fibre light meal?	(a) grilled chicken (b) cheese on wholemeal toast (c) beans on wholemeal toast (d) quiche
18	Which of these types of sandwich do you think is the healthiest?	(a) two thick slices of bread with a thin slice of cheddar cheese filling (b) two thin slices of bread with a thick slice of cheddar cheese filling
19	Many people eat spaghetti bolognese (pasta with a tomato and meat sauce). Which do you think is healthiest option?	(a) a large amount of pasta with a little sauce on top (b) a small amount of pasta with a lot of sauce on top
20	If a person wanted to reduce the amount of fat in their diet, which of these food options would be the best choice?	(a) steak, grilled (b) sausages, grilled (c) turkey, grilled (d) pork chop, grilled
21	If a person wanted to reduce the amount of fat in their diet, but didn't want to give up chips, which of these options would be the best choice?	(a) thick cut chips (b) thin cut chips (c) crinkle cut chips
22	If a person felt like something sweet, but was trying to cut down on sugar, which of these would be the best choice?	(a) honey on toast (b) a cereal snack bar (c) plain Digestive biscuit (d) banana with plain yoghurt
23	Which pudding do you think is the healthiest choice?	(a) baked apple (b) strawberry yoghurt (c) wholemeal crackers and cheddar cheese (d) carrot cake with cream cheese topping
24	Which cheese would be the best choice as a lower fat option?	(a) plain cream cheese (b) edam (c) cheddar (d) stilton
25	If a person wanted to reduce the amount of salt in their diet, which of these meals would be the best choice?	(a) ready made frozen shepherd's pie (b) gammon with pineapple (c) mushroom omelette (d) stir fry vegetables with soy sauce

Questions 26 – 29: Dietary Behaviour

Please circle your answers (write your answers for question 29 in the table provided)

No	Question	Answer options
26	Do you keep a food diary?	Yes No
27	Please circle the statement that best describes you with regards to making a change to your diet (e.g. eating less fat / less salt / less sugar / more fruit and veg).	1) I do not feel I need to make any changes. 2) I am considering making a change. 3) I am currently making small changes. 4) I have just made a significant change. 5) I have successfully made significant changes, and I am trying to maintain them.
28	Do you drink alcoholic drinks?	Yes No
29	If your answer was "yes", how much alcohol do you drink during a typical week? Please write the number of each type of drink in the table below. Remember to include drinks at home and away from home (e.g. in pubs, clubs or at parties).	

	Type of drink	Amount per week		
	beer / lager / cider / ale / bitter	Pints ……	Bottles/cans ……	Small bottles/cans ……
	A single measure of spirits (e.g. gin, whisky, sherry) [a double=2]	……		
	Glass of wine, including champagne	Small ……	Large ……	
	Bottles of other alcoholic drinks (e.g. Smirnoff Ice)	……		
	Other alcoholic drinks (please specify type(s) and number)	Type: …… No. …… Type: …… No. …… Type: …… No. ……		

Questions 30 – 36: Barriers to weight loss

Please give your answers on a scale of 1 = not true to 5 = very true

30	Healthy food choices are often not available at the times or places where I eat (e.g. at home, work or in restaurants).	
31	When I am very hungry I have trouble controlling what I eat.	
32	Sometimes I have difficulty controlling cravings for foods that aren't good for me (e.g. chocolate, sweets).	
33	My life is so busy that I have trouble finding time to eat properly.	
34	I have trouble estimating portion sizes.	
35	I have trouble estimating the calorie and fat content of food.	
36	Often the amount of effort I need to put into controlling what I eat doesn't seem worthwhile.	

Information about you:

Please circle the correct answer or write your responses where indicated

No	Question	Answer options
37	Are you male or female?	(a) Male (b) Female
38	How old are you?	(a) under 18 (b) 18 - 34 (c) 35 - 44 (e) 45 - 54 (f) 55 - 74 (h) over 75
39	What is your ethnic origin?	(a) White (b) Black (c) Asian (d) Other (Please specify) ……
40	What is the highest level of education you have completed?	(a) Primary school (b) Secondary school (c) O levels/GCSEs (d) A levels (e) Technical or trade certificate (f) Diploma (g) Degree (g) Post-graduate degree
41	What is your postcode?	M27 M30 M29 Other (Please specify): ……
42	What is your job? If you are not currently working now, what is your usual job? (Please be specific).	
43	Are you:	(a) single (b) married (c) in a partnership
44	What is your weight?	
45	What is your height?	
46	Which slimming club are you currently a member of?	Weight Watchers Slimming World Rosemary Conley Other (Please specify): ……
47	Have you been a member of a slimming club in the past? Please circle all that apply.	Weight Watchers Slimming World Rosemary Conley

		Other (Please specify): ……..
48	What do you get out of your slimming club membership?	

THE END Thank you very much for your time. If there are any comments you would like to make about this questionnaire, please do so below, they would be very welcome. …… …… ……
If you would like a copy of the final results, then please write your email address below and they will be sent to you. ……

Please hand back the questionnaire to your club representative

Appendix 5 Questionnaire justification

No	Question	Justification	Source	Why is this being asked
1	Brown sugar is much healthier than white sugar **T**/F	Establish nutritional knowledge	Dickson-Spillman, 2011	Assess knowledge of sugar
2	The same amount of beef steak and chicken breast contains equal calories T/**F**	Establish nutritional knowledge	Dickson-Spillman, 2011	Assess knowledge of lean meat
3	Oily fish (salmon/mackerel) contains more healthy fats than red meat **T**/F	Establish nutritional knowledge	Dickson-Spillman, 2011	Assess knowledge of fats
4	Bacon contains more calories than ham **T**/F	Establish nutritional knowledge	Dickson-Spillman, 2011	Assess knowledge of processed meats

5	Vitamins and minerals give the same amount of calories as carbohydrates and proteins: T/**F**	Establish nutritional knowledge	Feren, 2011	Assess knowledge of macronutrients & micronutrients
6	A food that is labelled ”low-fat” has always less calories than the regular version of the food: T/**F**	Establish nutritional knowledge	Klohe-Lehman, 2006	Assess knowledge of food labelling
7	The first ingredient listed in the ingredients list is always the one with the highest weight **T**/F	Establish nutritional knowledge	Feren, 2011	Assess knowledge of food labelling
8	To eat healthily, you should eat less fat. Whether you also eat less fruit and vegetables doesn’t matter T/**F**	Establish nutritional knowledge	Dickson-Spillman, 2011	To assess understanding of relevance of fruit & veg
9	A salad dressing made with mayonnaise is as healthy as the same dressing made with mustard T/**F**	Establish nutritional knowledge	Dickson-Spillman, 2011	To assess understanding of ‘health’ related food choice
10	If you decreased your food intake by 500 calories per day, how many pounds would you expect to lose in a week? **1-2,**2-3,3-4,4-5,5-6	Establish nutritional knowledge	Klohe-Lehman, 2006	To assess understanding of calories
11	How many cubes of sugar are in $^{1}/_{2}$L of Coca Cola? 5, 15,**25**,40	Establish nutritional knowledge	Feren, 2011	Assess awareness of sugary drinks
12	Which food below does not contain carbohydrates? Apple, hamburger, coke, milk, peas	Establish nutritional knowledge	Klohe-Lehman, 2006	Assess knowledge of macronutrients
13	A pound of fat equals about____ kcal ? 500,1500,2500,3500,4500	Establish nutritional knowledge	Klohe-Lehman, 2006	Assess knowledge of fats
14	Which of these ingredient lists do you think is the healthiest one? See list below • *Strawberry jam:* Sugar, strawberry, water, citric acid, pectin and potassium sorbate. (40 g berries per 100 g of jam).....	Establish nutritional knowledge	Feren, 2011	Assess knowledge of food labelling

	• *Strawberry jam without additives:* Strawberry, sugar, water, citric acid and pectin (46 g berries per 100 g of jam)..... ..... • ***Strawberry jam, homemade type:*** **Strawberry, sugar, water, pectin, malic acid and potassium sorbate (60 g berries per 100 g of jam)**.....			
15	Which of these plates with rice, chicken fillet and vegetables is the best to choose? See photo Plate 1  Plate 2  Plate 3 	Establish nutritional knowledge	Feren, 2011	Assess knowledge of balanced diet
16	Which would be the best choice for a low fat, high fibre snack? (tick one) (a) diet strawberry yoghurt **(b) raisins** (c) muesli bar (d) wholemeal crackers and cheddar cheese	Establish nutritional knowledge	Parmenter & Wardle, 1999	Assess ability to identify most appropriate food

17	Which would be the best choice for a low fat, high fibre light meal? (tick one) (a) grilled chicken (b) cheese on wholemeal toast **(c) beans on wholemeal toast** (d) quiche	Establish nutritional knowledge	Parmenter & Wardle, 1999	Assess ability to identify most appropriate food
18	Which kind of sandwich do you think is healthier? (tick one) **(a) two thick slices of bread with a thin slice of cheddar cheese filing** (b) two thin slices of bread with a thick slice of cheddar cheese filing	Establish nutritional knowledge	Parmenter & Wardle, 1999	Assess ability to identify most appropriate food
19	Many people eat spaghetti bolognese (pasta with a tomato and meat sauce). Which do you think is healthier? (tick one) **(a) a large amount of pasta with a little sauce on top** (b) a small amount of pasta with a lot of sauce on top	Establish nutritional knowledge	Parmenter & Wardle, 1999	Assess ability to identify most appropriate food
20	If a person wanted to reduce the amount of fat in their diet, which would be the best choice? (tick one) (a) steak, grilled (b) sausages, grilled **(c) turkey, grilled** (d) pork chop, grilled	Establish nutritional knowledge	Parmenter & Wardle, 1999	Assess ability to identify foods to assist weight loss
21	If a person wanted to reduce the amount of fat in their diet, but didn't want to give up chips, which one would be the best choice? (tick one) **(a) thick cut chips** (b) thin cut chips (c) crinkle cut chips	Establish nutritional knowledge	Parmenter & Wardle, 1999	Assess ability to identify foods to assist weight loss
22	If a person felt like something sweet, but was trying to cut down on sugar, which would be the best choice? (tick one) (a) honey on toast (b) a cereal snack bar (c) plain Digestive biscuit **(d) banana with plain yoghurt**	Establish nutritional knowledge	Parmenter & Wardle, 1999	Assess ability to identify foods to assist weight loss
23	Which of these would be the healthiest pudding? (tick one) **(a) baked apple**	Establish nutritional knowledge	Parmenter & Wardle, 1999	Assess ability to identify most

	(b) strawberry yoghurt (c) wholemeal crackers and cheddar cheese (d) carrot cake with cream cheese topping			appropriate food
24	Which cheese would be the best choice as a lower fat option? (tick one) (a) plain cream cheese **(b) Edam** (c) cheddar (d) Stilton	Establish nutritional knowledge	Parmenter & Wardle, 1999	Assess ability to identify foods to assist weight loss
25	If a person wanted to reduce the amount of salt in their diet, which would be the best choice? (tick one) (a) ready made frozen shepherd's pie (b) gammon with pineapple **(c) mushroom omelette** (d) stir fry vegetables with soy sauce	Establish nutritional knowledge	Parmenter & Wardle, 1999	Assess ability to identify most appropriate food

Dietary Behaviour

No	Question	Justification	Source	Why is this being asked
26	Do you keep a food diary? Yes/No	Establishing behaviour	B Bray	To ascertain dietary behaviour
27	Please circle which statement best describes you with regards to making a change to your diet? (eg. eating less fat /less salt / less sugar / more fruit and veg). 1) I do not feel that I need to make any changes 2) I am considering a change 3) I am currently making small changes 4) I have just made a significant change 5) I have successfully made significant changes, and I am trying to maintain them	Establishing behaviour	Charnley, G (2008)	Assess type of change w.r.t weight loss
28	Do you drink alcoholic drinks? Y/N	Establishing behaviour	Charnley, G (2008)	Assess impact of alcohol on

				dietary behaviour
29	If you drink alcoholic drinks, how much alcohol do you drink during a typical week? Remember to include drinks at home and away from home in pubs, clubs or parties**. (see table)**	Establishing behaviour	Charnley, G (2008)	Assess impact of alcohol on dietary behaviour
	Type of drink	**Amount per week**		
	beer / lager / cider / ale / bitter	Pints	Bottles/cans	Small bottles/cans
	Single measure of spirits (e.g. gin, whisky, sherry) (double=2)			
	Glass of wine, including champagne	Small	Large	
	Bottles of other alcoholic drinks (e.g. Smirnoff Ice)			
	Other alcoholic drinks, please state			
	Barriers to weight loss (scale of 1=not true to 5= very true)			
30	Healthy foods are often not available when it is time for me to eat (e.g., healthy choices not available at home, work, or in restaurants).	Establishing behaviour	Welsh, Jeffrey 2012	To understand why actual behaviour differs from knowledge
31	When I'm very hungry I have trouble controlling what I eat	Establishing behaviour	Welsh, Jeffrey 2012	To understand why actual behaviour differs from knowledge
32	Sometimes I have cravings for foods that aren't good for me (e.g., chocolate, sweets), that I have difficulty controlling	Establishing behaviour	Welsh, Jeffrey 2012	To understand why actual behaviour differs from knowledge
33	My life is so busy that I have trouble finding time to eat properly.	Establishing behaviour	Welsh, Jeffrey 2012	To understand 34why

				actual behaviour differs from knowledge
34	I have trouble estimating portion sizes.	Establishing behaviour	Welsh, Jeffrey 2012	To understand why actual behaviour differs from knowledge
35	I have trouble estimating the calorie and fat content of food	Establishing behaviour	Welsh, Jeffrey 2012	To understand why actual behaviour differs from knowledge
36	Often the amount of effort I need to put into controlling what I eat doesn't seem worthwhile	Establishing behaviour	Welsh, Jeffrey 2012	To understand why actual behaviour differs from knowledge

Information on the respondent

No	**Question**	**Justification**	**Source**	**Why is this being asked**
37	Are you male or female? (a) Male (b) Female	Socio-economic group confirmation	Parmenter & Wardle, 1999	To characterise respondents
38	How old are you? (a) less than 18 (b) 18 ± 34 (c) 35 ± 44 (e) 45 ± 54 (f) 55 ± 74 (h) more than 75	Socio-economic group confirmation	Parmenter & Wardle, 1999	To characterise respondents
39	What is your ethnic origin? (a) White (b) Black (c) Asian (d)± other Please specify:	Socio-economic group confirmation	Parmenter & Wardle, 1999	To characterise respondents

	j) Any other ethnic group Please specify:			
40	What is the highest level of education you have completed? (a) primary school (b) secondary school (c) O levels/GCSEs (d) A levels (e) Technical or trade certificate (f) Diploma (g) Degree (g) Post-graduate degree	Socio-economic group confirmation	Parmenter & Wardle, 1999	To characterise respondents
41	What is your home postcode Free text	Socio-economic group confirmation	Charnley, G, 2008	To characterise respondents
42	What is your job? If you are not working now, what is your usual job? (please be specific).	Socio-economic group confirmation	Parmenter & Wardle, 1999	To characterise respondents
43	Are you: (a) single (b) married (c) living as married (d) separated (e) divorced (f) widowed	Socio-economic group confirmation		To characterise respondents
44	What is your weight? Free text	Establish whether participant is overweight	B Bray	To determine BMI
45	What is your height? Free text	Establish whether participant is overweight	B Bray	To determine BMI
46	Which slimming club are you a member of currently? Weight watchers Slimming World Rosemary Conley Other	Necessary for study design	B Bray	To compare results between clubs
47	Have you been a member of a slimming club in the past (please write which one) Weight watchers Slimming World Rosemary Conley Other	Necessary for study design	B Bray	To provide qualitative information about behaviour
48	What do you get out of slimming club membership? Free text	Lifestyle information	B Bray	To ascertain the benefits
THE END Thank you very much for your time.				

If there are any comments you would like to make about this questionnaire, please do so below, they would be very welcome. . . . . .

Appendix 6 Questionnaire Scoring System

A: Nutrition knowledge scoring systems

	Scores	
	Correct	Incorrect
Nutrition knowledge questions	1	0
Brown sugar is much healthier than white sugar.	1	0
Equal amounts of beef steak and chicken breast contain the same number of calories.	1	0
Oily fish (salmon/mackerel) contains more healthy fats than red meat.	1	0
Bacon contains more calories than ham.	1	0
Vitamins and minerals give you the same amount of calories as carbohydrates and proteins.	1	0
A food that is labelled"low-fat" always has less calories than the regular version of that food.	1	0
The first ingredient listed in the ingredients on a food label is always the one with the highest weight.	1	0
To eat healthily, you should eat less fat. It doesn't matter whether you also eat less fruit and vegetables.	1	0
A salad dressing made with mayonnaise is as healthy as the same dressing made with mustard.	1	0
If you decreased your food intake by 500 calories per day, how many pounds would you expect to lose in a week?	1	0
How many cubes of sugar are in 500ml of Coca-Cola?	1	0
Which of these foods does not contain carbohydrates?	1	0
A pound of body fat is the equivalent of ? kcal	1	0
Which of these types of strawberry jam do you think is the healthiest, based on the lists of ingredients?	1	0
Which of these plates of rice, chicken fillet and vegetables do you think is the healthiest choice?	1	0
Which of these would be the best choice for a low fat, high fibre snack?	1	0
Which of these would be the best choice for a low fat, high fibre light meal?	1	0
Which of these types of sandwich do you think is the healthiest?	1	0
Many people eat spaghetti bolognese (pasta with a tomato and meat sauce). Which do you think is healthiest option?	1	0
If a person wanted to reduce the amount of fat in their diet, which of these food options would be the best choice?	1	0
If a person wanted to reduce the amount of fat in their diet, but didn't want to give up chips, which of these options would be the best choice?	1	0
If a person felt like something sweet, but was trying to cut down on sugar, which of these would be the best choice?	1	0

Which pudding do you think is the healthiest choice?	1	0
Which cheese would be the best choice as a lower fat option?	1	0
If a person wanted to reduce the amount of salt in their diet, which of these meals would be the best choice?	1	0

B: Barriers to weight loss scoring system

Barriers to weight loss	*Scores 1-5*
Healthy food choices are often not available at the times or places where I eat (e.g. at home, work or in restaurants).	
When I am very hungry I have trouble controlling what I eat.	
Sometimes I have difficulty controlling cravings for foods that aren't good for me (e.g. chocolate, sweets).	
My life is so busy that I have trouble finding time to eat properly.	
I have trouble estimating portion sizes.	
I have trouble estimating the calorie and fat content of food.	
Often the amount of effort I need to put into controlling what I eat doesn't seem worthwhile.	

C: Dietary Behaviour scoring system

Question	***Response***	***Score***
Do you keep a food diary?	Yes	5
	No	1
Please circle the statement that best describes you with regards to making a change to your diet (e.g. eating less fat / less salt / less sugar / more fruit and veg).	I do not feel I need to make any changes.	1
	I am considering making a change.	2
	I am currently making small changes.	3
	I have just made a significant change.	4
	I have successfully made significant changes, and I am trying to maintain them.	5
Do you drink alcoholic drinks?	Yes	1
	No	5

D: Nutrition scores

	% correct answers
Number of subjects	
List of questions	
Brown sugar is much healthier than white sugar.	68
Equal amounts of beef steak and chicken breast contain the same number of calories.	89
Oily fish (salmon/mackerel) contains more healthy fats than red meat.	93
Bacon contains more calories than ham.	46
Vitamins and minerals give you the same amount of calories as carbohydrates and proteins.	91
A food that is labelled "low-fat" always has less calories than the regular version of that food.	86
The first ingredient listed in the ingredients on a food label is always the one with the highest weight.	55
To eat healthily, you should eat less fat. It doesn't matter whether you also eat less fruit and vegetables.	82
A salad dressing made with mayonnaise is as healthy as the same dressing made with mustard.	93
If you decreased your food intake by 500 calories per day, how many pounds would you expect to lose in a week?	71
How many cubes of sugar are in 500ml of Coca-Cola?	27
Which of these foods does not contain carbohydrates?	20
A pound of body fat is the equivalent of ? kcal	30
Which of these types of strawberry jam do you think is the healthiest, based on the lists of ingredients?	64
Which of these plates of rice, chicken fillet and vegetables do you think is the healthiest choice?	89
Which of these would be the best choice for a low fat, high fibre snack?	73
Which of these would be the best choice for a low fat, high fibre light meal?	88
Which of these types of sandwich do you think is the healthiest?	50
Many people eat spaghetti bolognese (pasta with a tomato and meat sauce). Which do you think is healthiest option?	32
If a person wanted to reduce the amount of fat in their diet, which of these food options would be the best choice?	95
If a person wanted to reduce the amount of fat in their diet, but didn't want to give up chips, which of these options would be the best choice?	80
If a person felt like something sweet, but was trying to cut down on sugar, which of these would be the best choice?	84
Which pudding do you think is the healthiest choice?	71
Which cheese would be the best choice as a lower fat option?	50
If a person wanted to reduce the amount of salt in their diet, which of these meals would be the best choice?	88

Percentages are rounded to the nearest integer

D: Dietary Behaviour scoring system

Question	Response	No of Participants Score
Do you keep a food diary?	Yes	25
	No	30
Please circle the statement that best describes you with regards to making a change to your diet (e.g. eating less fat / less salt / less sugar / more fruit and veg).	I do not feel I need to make any changes.	0
	I am considering making a change.	5
	I am currently making small changes.	18
	I have just made a significant change.	9
	I have successfully made significant changes, and I am trying to maintain them.	23
Do you drink alcoholic drinks?	Yes No	45 10

F: Education Attainment scoring system

Question	Response	Rank
What was the highest level of education you have completed	Secondary	1
	O'Levels/GCSE	2
	A Level	3
	Tech/Trade	4
	Diploma	5
	Degree	6
	Post graduate	7

G: Age scoring system

Question	Response	Rank
How old are you?	18-34	1
	35-44	2
	45-54	3
	55-74	4

Appendix 7 Perceived barriers to weight loss and the benefits of commercial slimming clubs

7A. Barriers to weight loss

Category	No. of respondents giving a score ≥4
Sometimes I have difficulty controlling cravings for foods that aren't good for me	38
When I am very hungry I have trouble controlling what I eat.	28
I have trouble estimating portion sizes	15
Healthy food choices are often not available at the times or places where I eat	14
Often the amount of effort I need to put into controlling what I eat doesn't seem worthwhile	13
I have trouble estimating the calorie and fat content of food.	10
My life is so busy that I have trouble finding time to eat properly	9
Total No. of responses ≥4	**127**

7B. Benefits of membership of commercial slimming clubs.

Category	No. of references
Support	20
Advice/education	16
Fellowship	10
Exercise	9
Encouragement	9
Weigh in	8
Other	8
Motivation	6
Social	2
Total number of responses	**88**